TPOC AI #87
Title: Performance Measurement
Submitter: Mr Louis Scheiderich AFRL/IFEB-JITF
Assignee: JITF, 497IG/INDIC
Action: The JITF and 497IG will develop a proposal for incorporating performance measurments/testing into the Life Cycle Measurement Process.
Suspense: 1 Feb 2000

Proposal: Incorporating Performance Measurement & Consolidation Testing

Stephen Scheiderich
Litton PRC

February 2000

Performance Analysis &
Consolidation Engineering (PACE)
Air Force Research Laboratory
32 Brooks Rd, Building 240
Rome, NY 13441

Abstract

This proposal provides both the justification and the process to apply minimum performance requirements to fielded intelligience applications. It is suggested that applications be tested to verify minimum performance and Consolidated Application Server (CAS) requirements as specified by the DII COE Common Operational Picture (COP) and Joint Technical Architecture (JTA) and that they be added to the DoDIIS instructions to validate compliance requirements. This paper provides a discusssion of techniques for testing of performance requirements which have been levied against applications for delivering this performance on client/server systems. A recommendation covering the topic of performance and consolidation of applications is provided.

Introduction

The distributed environment and the associated costs with deploying large numbers of workgroup servers is reversing itself in the commercial world. The central server (mainframe of old), is enjoying a resurgence of sorts as companies de-emphasize the local LAN-based servers in favor of the newer intranet model. At its core, this approach uses an Enterprise class server that provides more power and speed, and centralized storage management. This results in a large reduction of the number of servers and system administrative resources.

This model would eliminate the proliferation of 'local' application servers, which seem to be inundating the workplace in favor of larger servers housing multiple applications, and provide a central repository and managable focal point for application and print services. However, these applications must conform to software practices which do not impact on either the operating system or other applications so they can coexist on these servers. They need to be managed in a consolidated environment.

The challenge is to consolidate applications on specific platforms which will provide acceptable performance levels to all users regardless of the application(s) they are using and to provide for growth both in terms of number of users and applications on the servers.

The Department of Defense Joint Technical Architecture (JTA) and the Defense Information Infrastructure (DII) and Common Operating Environment (COE) in the Common Operational Picture (COP) provide standards and requirements[1] which applications must conform to, in order to allow their consolidation and specify performance requirements so that they provide information to their operators in a timely manner.

Although the current DoDIIS instructions have some Consolidated Application Server (CAS) requirements, no formal testing is performed on applications being provided to the intelligience community to verify that they either conform to minumum performance capabilities or can be consolidated with other applications for optimal operational and cost efficiencies.

To address this condition, specific consolidation and performance requirements should be added to the DoDIIS instructions so that users and administrators of these programs can be certain of minimum capabilities. This paper focuses on the form that the DoDIIS instructions could take in order to implement practical methods for testing of performance and consolidation requirements in addition to the instructions already provided, as well as a discussion of each. A specific recommendation is made in support of capacity planning for Intelligience Mission Applications (IMAs).

Consolidated Application Servers

The fundamental issue in consolidating applications together is getting the Intelligience Mission Applications (IMAs) to co-exist on servers where the consolidation minimizes the impact on individual application performance. In order to accomplish this, capacity planning with the IMA's which are to be consolidated is necessary. But before applications can be considered for consolidation, they must

a) Function on the same Operating Systems and versions,
b) Conform to applicable network standards. Use unique network ports for communications, and unique identifiers for their executables and libraries. (configurable)
c) Use existing operating system services without changing them,
d) Conform to the X/Open CAE standards in the X11 windows environment (where applicable) or the Win32 APIs Window Management and Graphic Device Interface.[1]
e) Install on servers without impacting on any existing IMA on that server.
f) Provide orderly start-up and shutdown capabilities which do not impact on other applications currently running on a server.
g) Provide data storage capabilities which conform to DOD Directive 8320.1 which is implemented in the DII COE Shared Data Engineering (SHADE) Program so that independently developed databases can coexist on shared data servers. This is not interoperability, it is functional co-existence.
h) Use private libraries for functionality that is required for which there are no available shared or operating system libraries.
i) In accordance with the DII COE I&RTS and DISA policy, redundancy should not exist for a particular function of any COE segment. This requirement is not levied upon DoDIIS IMAs currently. Redundancy is to be avoided for consolidated applications to avoid resource contention.

Applications must be tested to confirm that they can coexist with other IMA's. Practically speaking, it is not possible to test every application with every other application which might be installed on the same server or workstation. It is possible however, to require consolidation with an application in order to test overlapping functionality along with the requirements listed above. This application would be an IMA which exhibits operations in every area in which it is desirable or required to coexist. This is a practical approach to ensuring consolidation requirements.

The analogy which is appropriate for this scenario is that of our roadways and the vehicles that use them. A vehicle which does not conform to weight, height, and length standards for traveling on our highways is not allowed on them. The infrastructure (road) exists to support specific users (vehicles). The users(vehicles), must conform to

[1] Joint Techincal Architecture (JTA) Version 3.0, 15 Nov 99, Pages 22,23

standards set by the creators/maintainers.

Performance considerations

Except for IMAs which must conform to the Common Operational Picture (COP) as specified by the Intelligence Production Decision Memorandum (IPDM), there are no specific minimum performance requirements for intelligience mission applications. The DoDIIS instructions indicate that all developers should strive to meet the minimum performance requirements specified by COP requirements.

The COP requirements call for timeliness in responses in order to support the warfighter. Software which takes to long to deliver its output might as well not work at all. In the future, sucessful engagements will be predicated on information superiority.[2]

Current DoDIIS Instructions leave performance considerations and consolidation to the installing system administrators. An administrator acquires a new intelligience application. He reads the installation manual and determines that the minimum hardware requirements are all he can provide with his current systems. He installs the software on a workstation and, after days of struggling to get the application operational, succeeds in getting it running. However, even though it is working correctly, it maybe too slow to be of any use.

Unfortunately, a mechanism for measuring both performance of IMAs and defining what hardware is appropriate for a specific set of Intelligence applications does not exist. The sites are left to their own devices to right-size their configuration for the optimal performance. They may buy the biggest server they can afford, or they place all of their IMAs on different servers.

In order to consolidate one application with another, the target hardware must be capable of supporting the level of resources needed by both IMAs. In order to facilitate consolidation, IMAs should identify the resources and level of use required by their operations. Currently, IMAs identify minimum hardware requirements in order to support the application. They sometimes provide multiple recommendations depending on the number of users. This is useful (if accurate,) to system administrators when the application is the only software targeted for those systems. It is of marginal value when trying to consolidate that IMA with other applications.

What is missing is the analysis of the usage of resources by the applications. A more thorough breakdown of resources is required;

1) The CPU power(number, type and speed),
2) The Network bandwith and port usage required,
3) Memory utilization,

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[2] Waltz, Edward, Information warfare : principles and operations. © 1998 ARTECH HOUSE, INC., 685 Canton Street Norwood, MA 02062, Pg 107

4) I/O bandwith and drive space required.
5) The whole of activity in measured transactions/sec (if applicable) or some other metric. (For example; SPEC or TPC benchmark comparative metrics)

An administrator could then determine both a minimum level of hardware for a stand-alone system or the combined requirements if consolidating with another application. If required performance capabilities were identified using standard benchmark metrics, then system administrators could use these standards to ascertain the capacity of the servers and workstations required for the consolidated environments.

The difficulty lies in obtaining these metrics in an objective environment. It would not be appropriate for the developers to take these measurements because of bias. It would be appropriate for an independent test facility to do this.

Performance Requirements

The Common Operating Picture (COP) defines timeliness requirements for applications which must support all warfighters from the CINC to the individual commanders in the field.[3]

These timeliness requirements can be directly translated into end-to-end performance requirements. They are very specific, and any application under test for these requirements must be deployed on the proper platform to insure the delivery of the data within these specifications.[4] This is a conundrum. The proper hardware configuration should be specified to meet or exceed performance requirements vs. meeting this requirement through constant re-installation on different platforms. Consider this happening at a site.

There are also undefined requirements for performance in the COP such as *'System stability shall not be degraded by use of imagery applications'*.[5] It is unclear how to test for this requirement other than monitoring applications under test for instabilities.

Lastly, the COP describes scalability requirements which are provided for *'bandwith and/or processing power-challenged'* [6] systems. This reference is for PCs and laptop users which might have poor connections and low CPU power at their disposal.

In the commercial world, Online Transaction Processing (OLTP) systems have for many years provided near real-time responses for transactions. It is true because it is a requirement of the environment. A person standing at an ATM will not wait 30

[3] COP TRS for DII COE 12/4/1998 Page 4
[4] COP TRS for DII COE 12/4/1998 Page 30,31,47
[5] COP TRS for DII COE 12/4/1998 Page 40
[6] COP TRS for DII COE 12/4/1998 Page 34

minutes for a balance inquiry. Ten seconds is the mandate for OLTP systems, it should be for IMAs as well. By definition, IMAs are mission critical, when they deliver unacceptable performance, for whatever reason, they endanger the success of the mission. DoDIIS instructions should establish minimum end-to-end user response time requirements for all IMAs in order to provide sites with an acceptable environment for operations.

Current relevant DoDIIS instructions

DoDIIS Instruction	Comments/Notes
DC13 PMs developing IMAs to support the COP shall support a COP interface.	This is the requirement that IMAs specified in the IPDM conform to COP specifications
DC25 All PMs and sites shall register their respective segment(s) prefix names and applicable information in the on-line segment registration database, which can be found at http://spider.dii.osfl.disa.mil/cm/online_db.html.	This is an important requirement that IMAs should be conforming to now as much as possible in order to allow consolidation. Even providing this information for IMAs that are in transition would be helpful to avoid naming conflicts with past incarnations of the application.
DC32 PMs shall review the SHADE information and compliance guidelines provided in the DII COE I&RTS and at http://diides.ncr.disa.mil/shade/.	DC32, DC33 and DC34 all refer to the SHADE program. Applications developed with these guidelines will consolidate well. If an application is not conforming to these
DC33 PMs shall implement the database segmentation, reuse, and data sharing concepts that are defined as an integral part of the DII COE SHADE Program.	guidelines then consolidation will be unlikely or troublesome.
DC34 PMs shall comply with DoD Directive (DoDD) 8320.1.	See above
DC35 By the date specified in the DoDIIS Calendar, the DRB, DoDIIS SIMO, ERB, and the DoDIIS Test Facility shall use DoDD 8320.1 as a criterion for milestone progression go/no go recommendations.	This requirement complements the consolidation go/no-go recommendation in providing incentive to PMs to transition to the DII COE and JTA environments which require consolidation to be implemented.
DC38 PMs shall comply with the DoD Joint Technical Architecture and DoDIIS Profile to the DoD Joint Technical Architecture and Defense Information Infrastructure Common Operating Environment.	Top level instruction for complying with DoD JTA and DII COE.
DC39 The DMB and the DoDIIS Test Facility should use JTA compliance as a criterion for milestone progression and go/no go recommendations and decisions.	No comment
DC40 PMs shall obtain DMB approval	Important Instruction for IMA developers.

to use OSs other than Sun Solaris or Microsoft Windows NT on a case-by-case basis.	Should be developing applications which run only on the TOS's
DC41 PMs shall continue to support legacy OS environments during the time period specified in the DoDIIS Calendar.	Extensions to this will have a negative impact on consolidation and performance of IMAs as well as implementation of DII COE
DC42 All DoDIIS sites shall be capable of testing with the TOSs.	Sites shouldn't be forced to the TOS's until the IMAs are.
DC43 All DoDIIS sites shall complete the transition to the TOSs by the date specified in the DoDIIS Calendar (for application and data servers used to house IMAs and workstation platforms used to interface with IMAs).	Sites shouldn't be forced to the TOS's until the IMAs are
DC44 All applications developed to Microsoft Windows NT shall be capable of executing on any platform that supports Microsoft Windows NT.	This is instruction is not a realistic requirement. A workstation that is capable of running NT is not necessarily capable of doing anything else. The OS places a large load on the hardware in low-end installations. For example: A <32Mb RAM computer (regardless of the CPU) cannot realistically be expected to run ANY application well. It is already starved for memory. Minimum requirements should be specified for this instruction.
DC47 PMs developing Windows NT-based applications should coordinate with the DoDIIS Test Facility to determine the requirements for Microsoft Logo testing.	The DoDIIS test facility is one place to get this information, others can and should be specified in order to validate the requirements independently for PMs.
DC48 The DoDIIS Test Facility shall perform Microsoft Logo Testing for IMAs developed to Microsoft Windows NT.	When appropriate.
DC62 PMs shall design applications with options that provide users with the capability to reduce the volume and type of information transmitted (e.g., options that allow users to turn off graphics or compress data), or implement a component-based architecture that minimizes the amount of data passed	This instruction is similar to the requirement in the COP TRS for 'power challenged' systems. It should be more specific about levels of data passed as in rates and/or bandwith. (For example: 56k modem transfer capability)

between the server and remote clients.	
DC63 PMs shall not modify resources shared among all applications executing on a server.	This should also specify that only O.S resources should be shared. Anything else should NOT be shared.
DC64 PMs shall ensure that any planned or abnormal termination of an application does not adversely affect any other application that is executing on the same platform.	This instruction should also include start-up routines here as well.
DC65 PMs shall not design, develop, integrate and test, or deliver IMAs intended for a 1:1 ratio, IMA to server.	A consolidation instruction referencing single-use systems.
DC66 Performance and site administration considerations shall serve as guidance for the number of IMAs that will execute on a single server platform.	While this is important, system administrators do not have the proper information, tools or training necessary to make this judgement call right now.
DC67 The DMB staff and DoDIIS Test Facility shall use the CAS requirement as a criterion for a milestone progression go/no go recommendation.	When appropriate.
TF4 Ensure COTS products designed and intended to function solely in an IMA environment undergo the DoDIIS Certification process, i.e., test and evaluation to verify integration and interoperability with other systems, prior to installation at DoDIIS Sites.	When appropriate.

Proposed DoDIIS instructions
Specifically mandate that IMAs function on the target Operating Systems and versions and that installation programs identify and accommodate the version currently residing on the computer. Most commercial programs identify the version of the operating system and either notify that they cannot be installed or install the application for use on that version. (Sun Packaged Applications check for prerequisites and Windows Logo Testing checks for Win32 API functionality)
Install on systems without impacting on the functionality of any existing IMA on that server/workstation.
DoDIIS Test facility shall determine the minimum resource requirements for proper operation of an IMA to facilitate consolidation and allow system administrators to plan for installations These resource requirements would be documented by the DoDIIS test facility and provided in the installation manual or as an addendum to it. They would take the form of number of CPUs, type and speed, memory required, network bandwith required, and disk type and space required. Other requirements may need to be determined. (Change DC66 to this requirement)
Conform to applicable network standards. Use unique network ports for communications, and unique identifiers for their executables and libraries.
Provide configurable network interface port assignments, and identifiers for executables and libraries. This is not a DII COE or JTA requirement. This would provide a capability that most (if not all) applications do not have now. They could be configured to co-exist with other applications even if they shared COTS products.
Provide orderly start-up and shutdown capabilities which do not impact on other applications currently running on a server. (Modification to DC64)
Use private libraries for functionality that is required for which there is no available shared or operating system libraries.
Specifically include all COP requirements for IMAs which are referenced in the IPDM.
Establish minimum end-to-end user response time requirements for all IMAs in order to provide sites with an acceptable environment for operations. In the commercial world, Online Transaction Processing (OLTP) systems have for many years provided near real-time responses for transactions. It is true because it is a requirement of the environment. A person standing at an ATM will not wait 30 minutes for a balance inquiry. Ten seconds is the mandate for OLTP systems, it should be for IMAs as well.

Conclusion

The proposed changes and additions to the DoDIIS instructions provided in this paper are realistic suggestions to improve the installation and function of IMAs. They are intended to expedite a discussion among the appropriate organizations resulting in a decision on their adoption.

Performance analysis and consolidation of applications that presents significant challenges to any organization. However, in the commercial world, the rewards far outweigh the risks, and so consolidation is becoming a goal that corporations are aspiring to as a part of reengineering. The contribution to the bottom line is the primary motivation.

One of the benefits of consolidated servers is the reduction in system administrative personnel required to maintain the servers. The shortage of skilled personnel in this area is acute.

Performance of Intelligience Mission Applications(IMAs) reaching the sites is another consideration which is of concern to users. Methods need to be in place to ensure that IMAs being developed are capable of delivering data at an acceptable rate for information superiority.

These benefits: reduced overhead, reduced system administrative expense, and reduced hardware costs all combine to provide a strong case for moving towards augmentating thr DoDIIS Instructions with the proposed changes. Consistent and predictable performance by an application is what makes it a good candidate for consolidation. Instructions mandating this consistency and performance are greatly needed in order to deliver the services required for the mission success.